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DEAFNET: Deaf-friendly Communication Network

Vanshika Rajvanshi[1], Shalini Singh[2], Ushmita Patil[3], Prof. Prabhavathi K*[4]

[1,2,3]Student Department of Computer Science and Engineering, RV Institute of Technology and Management, Visvesvaraya Technological University, Bengaluru, Karnataka, India.
[4]Assistant Professor, Department of Computer Science and Engineering, RV Institute of Technology and Management, Visvesvaraya Technological University, Bengaluru, Karnataka, India.

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Abstract: Hand gestures play a crucial role in sign language, facilitating non-verbal communication primarily for individuals facing hearing or speech challenges. Sign language systems, developed globally, aim to aid the communication needs of the deaf and mute community. However, existing systems often lack flexibility and cost-effectiveness. In response to these limitations, this software introduces a prototype that autonomously recognizes sign language, promoting more effective communication for individuals with hearing or speech impairments when interacting with both their peers and those without such challenges.
Despite a wide social group that could profit from it, the idea of sign language recognition by technology is underutilized. Several technologies are available that can be helpful in establishing a link between this social group and the rest of the world. One of the main tools for enabling sign language users to communicate with the rest of society is understanding sign language. Computers can recognize sign language with the use of image categorization and machine learning, which can then be translated by humans. This study uses convolutional neural networks to identify sign language motions. The static sign language gestures were photographed using an RGB camera and comprise the image dataset used. The photos underwent preprocessing before being used as the input that had been cleaned. Inception v3 convolutional neural network model was used to retrain and test this dataset of sign language motions, and the findings are presented in this study. Several convolution filter inputs are processed on a single input in the model.
The resulting validation accuracy was greater than 90%. The numerous attempts at sign language detection using machine learning and image depth data are also reviewed in this work. It assesses the different difficulties involved in solving the issue at hand and describes the problem's potential future.
Keywords: Sign Language Recognition, Deep Learning, Inception V3, Image Processing.

INTRODUCTION

Human communication relies on the effective expression of ideas, thoughts, and experiences through speech,enabling individuals to convincingly convey their perspectives to those around them. It is unjust to overlook those who lack this valuable gift, forcing them to depend on interpreters or visual communication methods.

Unfortunately, interpreters may not always be readily available, and visual communication can be challengingto comprehend. For individuals in the deaf and mute community, Sign Language serves as their primary mode of communication. However, its use is often limited to within their families or the deaf and mute community,as those who are not part of this community may be unaware of the grammar and meanings behind various gestures. This communication barrier can be overcome by converting sign language into text, allowing for thetransmission of emails to the intended recipients.

The goal of sign language recognition is to provide an accurate and convenient mechanism for transcribing sign gestures into meaningful text or speech. This facilitates seamless communication between the deaf and hearing communities. Numerous proposals have been made to create fully automated systems or Human-Computer Interaction (HCI) solutions, aiming to bridge the communication gap between deaf and non-deaf individuals.

The conventional system for sign language recognition primarily relies on hand recognition techniques, facilitating communication between individuals with normal hearing and those who are deaf. In our project, we leverage a combination of sign language and behavioral signals, enhancing our ability to discern the intended communication. This integration proves particularly valuable in security- related fields. Through the incorporation of various signs and the application of instance learning algorithms, we can achieve more accurate communication with individuals.

Our project utilizes hand recognition to establish communication with both deaf and mute individuals, allowing for the display of letters, words, or other conveyed messages. The software system is specifically designed for hand gesture recognition. It captures and computes various parameters associated with the person's gesture. By identifying and recognizing

***Corresponding Author:** Prof. Prabhavathi K

these parameters, the system compares them with known gestures for human communication.

This comparison allows the system to interpret the person's communication state based on their static gestures.The proposed system goes beyond traditional hand recognition techniques by incorporating behavioral signals, contributing to improved accuracy and effectiveness in communication, especially in security-relatedapplications.

LITERATURE SURVEY

The professionals in India have expressed concerns about a shortage of special schools for deaf individuals, with only a few incorporating sign language as a medium of instruction. Additionally, inadequate audio-visualsupport in oral education has been identified as a contributing factor to poor communication and language skills among deaf children, impacting literacy within the deaf community. Surprisingly, Indian Sign Language(ISL) is not widely used in deaf schools, with approximately 5% of deaf individuals attending such schools. The limited use of ISL is often restricted to vocational programs and short-term courses.

1. "Implementation of Sign Language" (IJARCCE) - July 2022 by Srijith S Bhat, Omkar K Hedge, GaneshN Bhat, Sanjeevini S M, Ashwini D S - This work addresses the challenge of recognizing sign language, employing machine learning for enhanced accuracy and reliable results in handling data. The focus is on identifying sign expressions used by individuals who are deaf and mute.
2. "Real-Time Sign Language Interpreter" by Geethu G Nath, Arun CS -July 2021 - A hand sign recognition system is implemented using an ARM CORTEX development board. This system assists deaf mute individualsin conveying messages to normal people without the need for an interpreter, contributing to increased independence in communication.
3. "Implementation of Real-Time Hand Gesture Recognition" by Manasa Srinivasa H S, Suresha H S - May 2022 - This project utilizes an Intel Atom processor and OpenCV to identify the number of fingers unfolded, with potential applications in aiding physically challenged individuals in tasks such as wheelchair movementand robot operation.
4. "Sign language recognize system for communication to people with disabilities" by Yulius Obi, Kent Samuel Claudio, Vetri Marvel Budiman, Said Achmad, Aditya Kurniawan - July 2023 - Using American Sign Language (ASL) datasets and Convolutional Neural Networks (CNN), this research focuses on achieving high accuracy (96.3%) in recognizing the 26 letters of the alphabet through hand gestures.
5. "SIGNFORMER: DeepVision Transformer for Sign Language Recognition" by Deep Kothadiya, Chintan Bhatt, Tanzila Saba, Azmat Ullah Khan - June 2023 - Recognizing the significance of sign language for the hearing impaired, this research introduces SIGNFORMER, a DeepVision Transformer designed to enable normal individuals to recognize sign language, thus bridging the communication gap with those who are hearing impaired.
6. "A hybrid approach for Bangla sign language recognition using deep transfer learning model with randomforest classifier" by Sunanda Das,Md. Samir Imtiaz,Nieb Hasan Neom,Nazmul Siddique,Hui Wang – July 2023 - Sign language, like any natural language, has a wide range of expressions in different parts of the world. Over the years, some sign languages, such as American Sign Language (ASL), and Indian Sign Language (ISL) have gained prominence over others. To have a better understanding of the state of the art, we looked at several of these sign language recognition systems as well as certain Bengali Sign Language (BSL) recognition systems.

PROPOSED APPROACH
PROPOSED SYSTEM

The envisioned system for sign language recognition for individuals with hearing and speech impairmentsaims to enhance communication support and accessibility for those who rely on sign language. Notably, the Indian sign language faces unique challenges compared to its American counterpart, mainly due to theabsence of standardized datasets and regional variations. Key features of the proposed system include:

Gesture Recognition: The system must accurately recognize and interpret sign language gestures using computer vision and machine learning algorithms. This encompasses detecting and understanding hand movements, finger spelling, and facial expressions.

Real-time Translation: The system should possess the capability to translate sign language gestures intospoken or written language in real-time. This functionality may involve the application of natural language processing (NLP) and speech synthesis technologies.

User-Friendly Interface: An intuitive and user- friendly interface is essential, enabling users to interact seamlessly with the technology. Gesture- based controls and visual feedback can contribute to a smooth communication experience.

Privacy and Security: Emphasis should be placed on prioritizing user privacy and data security. The system must handle user interactions and data responsibly and securely to build user trust.

Integration with Assistive Technologies: The system is designed to integrate seamlessly with other assistive technologies such as text-to-speech, voice recognition, and screen readers. This integration ensures a comprehensive communication solution that caters to diverse user needs.

***Corresponding Author:** Prof. Prabhavathi K

Feedback Mechanism: A feedback mechanism should be incorporated, allowing users to provide input and report any issues or inaccuracies in sign language recognition. This feature promotes continuous improvement and refinement of the system.

PROPOSED METHODOLOGY

The proposed model emphasizes a deep network architecture that which is used to recognize the signs through the hand gestures those which are numeric gestures using Convolution Neural Network (CNN) from the deeplearning and with the help of OpenCV. Here, CNN is used to train the dataset and OpenCV is used to capturethe hand gestures. As very few people understand sign language as it is not an international language. This makes it difficult for the majority of hearing communities to communicate with the deaf community. Hence automatic recognition system is a new way of understanding the meaning of deaf signs without needing the help of expert. Where, our proposed model can be used to recognize the signs.

The overall goal is to create a technologically advanced and user-centric system that not only recognizes and translates sign language effectively but also aligns with the broader context of assistive technologies and user feedback for continuous enhancement.

SYSTEM ARCHITECTURE

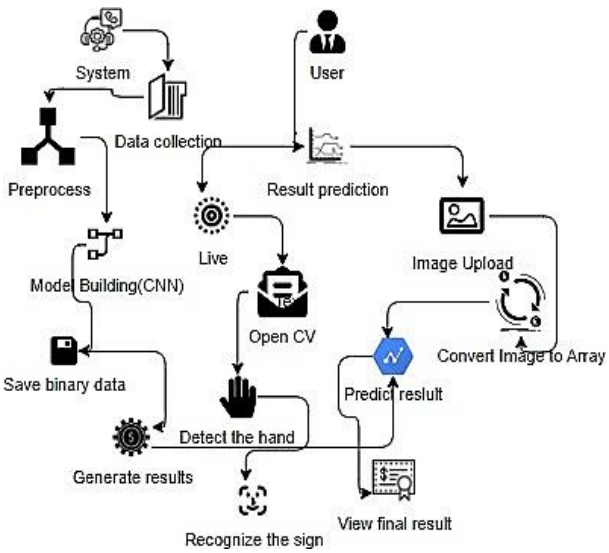

Figure 1: System Architecture

RESULTS & DISCUSSIONS

Initially, we have certain services that are offered by this project like speech and image recognition and also live prediction where through live camera the gestures will be detected by the camera given by the user and will be seen on the screen.

Figure 2: Home Page

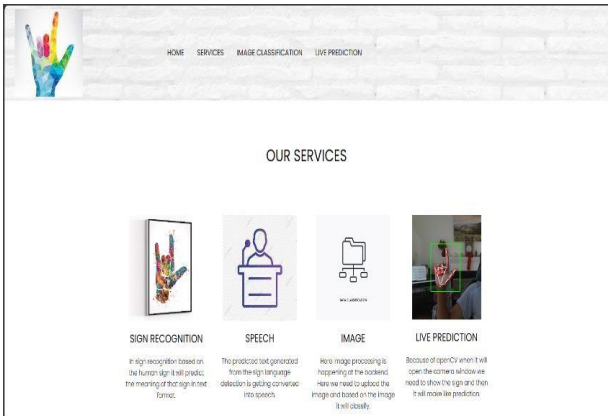

Figure 3: Services Offered

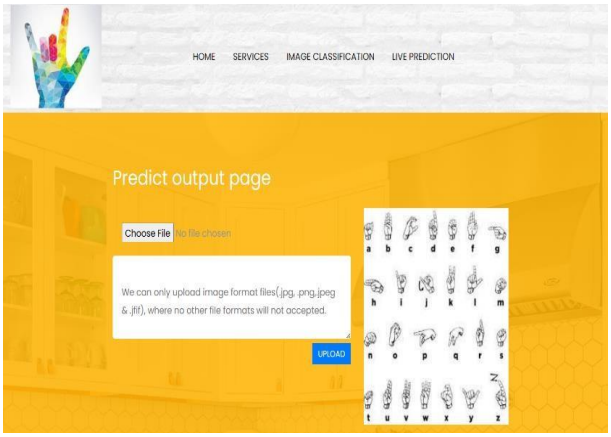

Figure 4: Detecting gesture by uploading pic

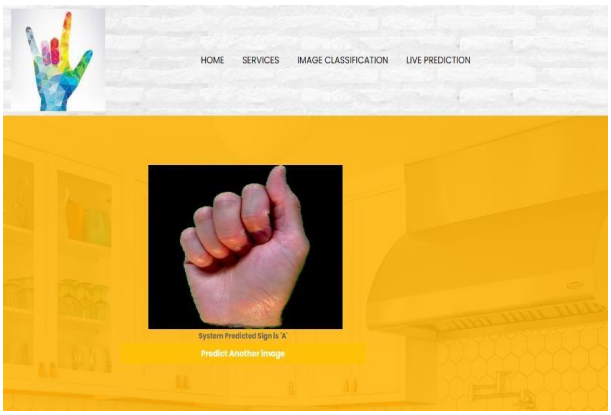

Figure 5: Output by image upload

***Corresponding Author:** Prof. Prabhavathi K

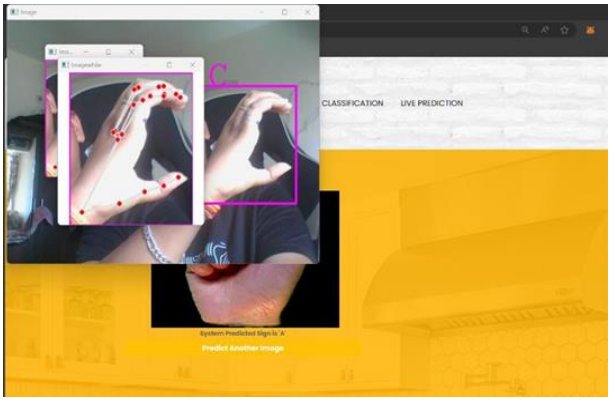

Figure 6: Output by Live Prediction

Application And Future Enhancement

While CNN technology for speech recognition offers several potential advantages, it also presents some notable disadvantages that should be considered:

- Complex Gestures Recognition: The system may encounter difficulties accurately recognizing complex or dynamic sign language gestures, especially those involving movement or non-static hand shapes.
- Limited Language Support: Focusing on Indian sign language may restrict the system's applicability to other sign languages, potentially excluding individuals who use different sign language systems worldwide.
- Technological Dependency: The system's reliance on depth images and technology for recognition may posechallenges in environments with poor lighting conditions or limited access to the required technological infrastructure.

Future enhancements for sign language recognition using Convolutional Neural Networks (CNNs) include integrating more diverse sign language datasets to improve model robustness, implementing real-time recognition for dynamic signing, exploring 3D CNN architectures for depth information, and incorporating attention mechanisms for fine-grained feature focus. Additionally, leveraging transfer learning and domain adaptation techniques to facilitate model adaptation for specific sign languages or users could enhance system performance. Lastly, integrating haptic feedback or augmented reality for improved user interaction and accessibility would further advance the usability and impact of the sign language recognition system.

CONCLUSION

In conclusion, deep learning has shown great potential in sign language detection. With the help of convolutional neural networks (CNNs) and recurrent neural networks (RNNs), accurate recognition of sign language gestures can be achieved. Deep learning models have been trained on large datasets of sign language videos, allowing them to learn the subtle differences between signs and interpret them correctly. Sign languagedetection using deep learning has numerous applications, including improving communication between the deafand hearing communities, creating more accessible technologies for the deaf and hard-of-hearing, and facilitating communication in noisy environments where speech recognition may be challenging.

This innovation holds the potential to significantly enhance communication between the deaf and hearing communities. The project's implementation involves various critical stages, including data collection, pre- processing, feature extraction, model training, and real- time gesture recognition.

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